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The Influence of Relationships on Inter-Organizational Information Systems Usage and Supply Chain Performance

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Abstract: Due to the cross-boundary characteristic of inter-organizational information systems (IOS), its usage is affected by inter-organizational relationships (IORs), which plays an even more important role in China. This paper develops a conceptual model of the influence of IORs on IOS usage and supply chain performance. Based on organizational learning theory, the paper divides patterns of IOS usage into IOS use for exploitation and exploration. And the paper puts forward an innovative perspective to evaluate supply chain performance from efficiency and flexibility dimensions. Using a sample of 151 Chinese companies, structural equation modeling (SEM) is applied to empirically test the hypotheses. The finding indicates that inter-organizational trust has significant positive influence on IOS usage, while power and cooperative norms do not. And IOS usage plays a positive role in promoting supply chain performance and exploitative usage is better for the efficiency promotion. Therefore, much attention ought to be paid to nurture inter-organizational trust rather than power to promote IOS usage and supply chain performance.

Keywords: inter-organizational relationships, inter-organizational information systems, supply chain performance, structural equation modeling

1. INTRODUCTION

Facing the increasingly complex and dynamic competition environment, companies seek to gain competitive advantages by effective supply chain management (SCM)^[1]. The fact that inter-organizational information systems (IOS) can span organizational boundaries makes it possible to achieve effective management of organizations^[2]. To improve the supply chain performance, IOS is introduced to supply chain management^[3]. However, there exists IT productivity paradox in the process of off-the-shelf technology usage^[4]. The adoption of IOS are only the preconditions for gaining competitive advantages, which can't have a positive impact on supply chain performance until it's used effectively^[5]. In addition, organizations can succeed only when they engage themselves in exploiting the existing knowledge and exploring the new^[6]. So IOS ought to be used to support exploitive and explorative activities of organizations to promote the performance.

The influence of technological, organizational and environmental factors on IOS adoption and usage are widely researched^[7]. Due to the cross-boundary features of IOS, the inter-organizational relationships (IORs) have been indicated to be especially critical in enhancing the adoption^[8]^[9]. Chinese culture is typically long-term oriented, and supply collaboration is largely based on inter-organizational trust^[10]. Characteristic of high power distance makes organizations tend to apply coercive power in the face of collaboration conflict^[11]. However, application of power might damage inter-organizational trust and cooperation norms^[12]. The influence of trust, power and cooperative norms on IOS usage maybe various and interactive, but few investigations has been made in this area.

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Besides that, existing researches mainly focus on problems such as information technology adoption or something related to application level. However, related studies can't explain the reason why the use of same information systems produce different supply chain performances in similar context and application level^[13], i.e., there are inconsistencies in the relations between IORs, IOS adoption and supply chain performance. The patterns of IOS usage is one of the key factors that affect the supply chain performance, while existing researches are far from enough on it^{[5][13]}. To fill the gap, we study the influence of relationships on patterns of IOS usage and supply chain performance.

The paper aimed to investigate the influence of inter-organizational relationships such as trust, power and cooperative norms on IOS exploitative usage, explorative usage and supply chain efficiency, supply chain flexibility in the context of China. The rest of the paper is organized as follows. Section 2 provides the theoretical framework and hypotheses. Section 3 describes the research methodology and the results of structural equation modeling. Section 4 is the discussion and conclusions.

2. THEORETICAL DEVELOPMENT AND HYPOTHESES

Figure 1 presents the model examined in this research. It shows linkages that are hypothesized to exist among inter-organizational relationships, patterns of IOS usage, supply chain performance.

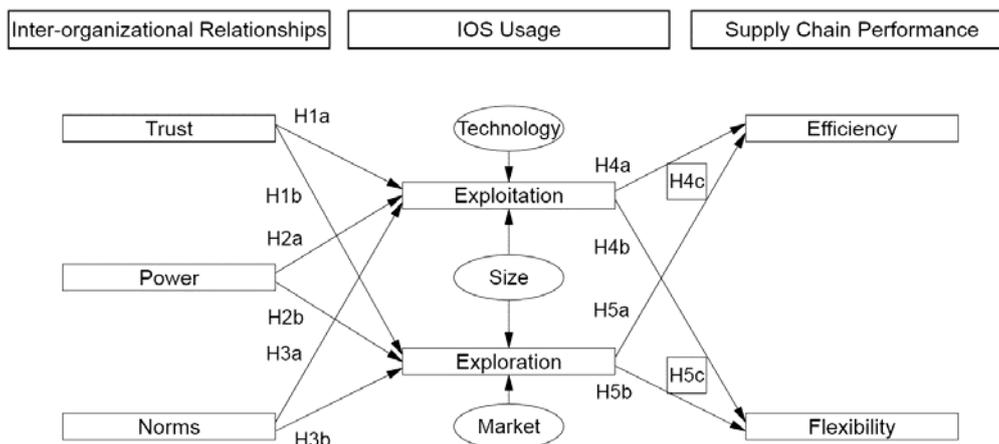


Figure 1. The theoretical model

Firms in supply chain can get the actual or potential resources from their own social network, which is the social capital that can bring benefits for specific actions and actors, in fact, trust is the main social capital^[14]. In many cross-cultural studies, Chinese society is considered to be a low-trust society^[15]. Hitt et al (2000) presents that the greater the institutional distance is, the more likely organizations choose a trusted partners^[16]. China belongs to the typical low trust, high institutional distance culture, so trust among organizations may play an important role once formed^{[17][18]}.

Organizational trust can simplify the complexity of the supply chain system, promote consistency of decision-making behavior, improve the level of collaboration, enhance the professional level, at last, improve the level of IOS use for exploitation^[19]. Trust between organizations can reduce the expectation of opportunistic behavior, enhance the relationship integration and cooperation, and externalize tacit technical knowledge, which contribute to identifying preference segments, innovating products, enhancing the ability to cope with uncertainty and improve the level of IOS use for exploration^{[20][21]}. Based on the above analysis, we hypothesize:

Hypothesis 1. Trust is positively related to both exploitative and exploratory use of IOS.

Based on the *resource dependence theory*, organization's behavior is affected by external factors, the organization can reduce uncertainty by taking actions^[22]. The core action is power, which means the control of vital resources. Organizations often attempt to reduce power from other organizations, but increase their power over other organizations. Owing to the characteristics of high power distance, coercive power is more likely to be applied when an organization tries to affect partners in China^[11]. And non-coercive power and trust tend to produce a similar effect in relationship management, so this paper mainly focuses on coercive power^[11].

Power contributes to promoting the level of IOS use for exploitation. The target may not be exactly same in different organizations in the process of IOS usage^[11]. In this case, inter-organizational conflicts increasing the uncertainty of the supply chain collaboration. When the resource among organizations is imbalance, organizations can reduce the uncertainty by applying power^[23]. So inter-organizational power can promote the level of IOS use for exploitation by improving the efficiency of inter-organizational collaboration and the professional level of the organization. However, the concentration of power may inhibit exploratory activities of organizations, dispersion of power is very important, which could provide support for innovation activity, concentration of power is likely to hinder the appearance of thoughtful solutions^[24]. So the inter-organizational power may have a negative effect on the IOS use for exploration by hindering the innovative energy and motivation. It's thus hypothesize that:

Hypothesis 2. *Power is positively related to exploitative use of IOS, but is negatively related to IOS exploratory use.*

Organizations face two kind of environments: the technical environment and institutional environment, technological environment requires its pursuit of efficiency, however, the organization is also the product of the institutional environment^{[25][26]}. Institutional environment include the legal system, cultural expectations, social norms, shared social facts and so on^[27]. Organizations are embedded in institutional environment, the survival and development of organization depends on the obedience to institutional environment and the adherence to social norms^[25]. As an informal system, cooperative norms comes to effect when formal system is missing.

Cooperative norms reflect expectations the two exchanging parties have about working together to achieve mutual and individual goals jointly^[28]. Obedience to norms contributes to reduce the fear of uncertainty in supply chain collaboration. And it makes for sharing responsibility, taking into account for each other's interest, maintaining cooperative relationships in the process of collaboration^[29]. Under the guidance and constraint of cooperation norms, it's easily to reach an agreement, reduce conflict and improve the level of IOS use for exploitation. Exploratory activities are inherently uncertain, which may increase the organizational risks^[6]. Organizations tend to sharing risk, which enhance the willingness and actions on exploratory activity^[30]. In addition, cooperative norms contribute to increasing the quality and quantity of shared information, finding opportunities for improvement, finally, improving the level of IOS use for exploration. It's thus hypothesize that:

Hypothesis 3. *Cooperative norms is positively related to both exploitative and exploratory use of IOS.*

Organization is an adaptive system, for the purpose of improving performance and enhance their competitive advantage in the dynamic competitive environment, the central issue of the organization is to exploit the existing certainty and explore new possibilities^[6]. In this study, IOS usage pattern is divided into exploitative usage and exploratory usage.

IOS use for exploitation contributes to promoting supply chain efficiency by improving existing knowledge and skills in a more stable premise^[31]. IOS use for exploration makes for promoting supply chain flexibility by exploring new knowledge coping with the risk^[32]. Besides, supply chain efficiency could be improved by

learning better business practices, getting opportunity to optimize business process in the process of exploration. However, the linkage between exploration and optimization of business processes is often indirect, incidental^[13]. So IOS use for exploration is weaker for supply chain efficiency than exploitation. Supply chain flexibility could be improved with the accumulation of experience in the process of exploitation^[33]. However, there exists barriers owing to the misunderstanding the shared information, and it's difficult to recognize it, which leads to the weaker linkage between exploitative usage and supply chain flexibility^[13]. It's thus hypothesize that:

Hypothesis 4. *The higher the level of IOS use for exploitation, the greater level of supply chain performance, and the association of exploitation with supply chain efficiency is stronger than the association of exploration with efficiency.*

Hypothesis 5. *The higher the level of IOS use for exploration, the greater level of supply chain performance, and the association of exploration with supply chain flexibility is stronger than the association of exploitation with flexibility.*

2.4 Control variables

To eliminate potential confounds, technology turbulence, market turbulence, and organization size are added as control variables which may influence the relationships between key variables in the model. If technology development is slow, organizations mainly face structural problems, which could be solved only by exploiting existing technology^[31]. Organizations have to deal with the demand and practices turbulence in a dynamic market environment, organizations will be eliminated owing to the lack of exploration activities to adapt to the change^[34]. Therefore, the higher the level of technology turbulence, the higher the level of IOS use for exploitation; and the higher the level of market turbulence, the higher the level of IOS use for exploration. In addition, organization size may affect IOS usage. The larger the organization is, the more resource and technology might be possessed by organizations, which provide the basis for IOS usage^[35]. So, the larger the organization is, the higher the level of IOS use for exploitation and exploration.

3. METHODS AND RESULTS

3.1 Data collection and assessment of construct

All instruments are developed from the literature, which contributes to ensure content validity^[36]. 754 invitations have been sent to participate the survey. 151 valid samples are got in the study. The valid return rate is 18.0% when effective invitations are as the number of invitation, which is in an acceptable range.

Cronbach's alpha (α) is used in the study. Table 1 shows the alpha values of every construct. All values range from a low of 0.668 to a high of 0.921, exceed the recommended critical value of 0.60. In sum, the overall reliability for the study constructs on IORs, IOS usage and supply chain performance could be considered satisfactory.

The hypotheses are tested by adopting structural equation modeling (SEM). The goodness of fit indices are $\chi^2/d = 1.083 < 2.00$, $RMSEA = 0.024 < 0.05$, $GFI = 0.796 < 0.90$, $IFI = 0.890 < 0.90$, $PGFI = 0.662 > 0.50$, $PCFI = 0.767 > 0.50$ ^[37]. It shows that measures of fit reach a critical level or get close to it. Therefore, the overall fit of the structural equation model is acceptable.

Harmon's one-factor test is run to ensure that common method variance do not account for our findings in the study. The results of unrotated principal components analysis reveals that nine factors with eigenvalues greater than 1 are extracted, which account for 73.6% of the total variance. What's more, the first factor don't account for the majority of the variance (23.7%). It indicates that no single factor emerges that accounts for most of the variance, so common method bias does not appear to be a problem in the study.

Table 1. Descriptive statistics and Cronbach's alpha

Construct	Number of Items	Mean of Items		Cronbach's alpha
		Minimum	Maximum	
Trust (A)	3	4.51	4.83	.832
Power (B)	4	3.15	3.89	.882
Norms (C)	3	4.19	5.36	.729
IOS use for Exploitation (D)	3	5.11	5.52	.871
IOS use for Exploration (E)	4	4.11	4.52	.921
Supply chain Efficiency (F)	4	5.26	5.30	.895
Supply chain Flexibility(G)	4	4.96	5.11	.881
TechnologyTurbulence (H)	4	4.56	4.97	.871
MarketTurbulence (I)	3	4.42	5.58	.668

3.2 Hypotheses testing

The standardized estimation results of structural equation modeling shows that the path from control variables to IOS usage are all significant except technology turbulence ($\lambda_7=0.176$, $p=0.078$). The results of hypothesis testing are summarized below.

Hypothesis 1, Supported: The path from inter-organizational trust to IOS use for exploitation ($\lambda_1=.412$, $p<.001$) and exploration ($\lambda_2=.451$, $p<.001$) are positive and significant.

Hypothesis 2, Unsupported: The path between power and IOS use for exploitation ($\lambda_3=.124$, $p=.285$) is positive and the path from power to IOS use for exploration ($\lambda_4=-.013$, $p=.925$) is negative, but they are not significant.

Hypothesis 3, Unsupported: The path from cooperative norms to IOS use for exploitation ($\lambda_5=.291$, $p=.054$) and exploration ($\lambda_6=.043$, $p=.781$) are positive but not significant at the 0.05 level.

Hypothesis 4, Supported: The path from IOS use for exploitation to supply chain efficiency ($\beta_1=.524$, $p<.001$) and flexibility ($\beta_2=.745$, $p<.001$) are positive and significant. What's more, the path between exploitation and efficiency ($\beta_1=.524$, $p<.001$) is greater than that between exploration and efficiency ($\beta_3=.283$, $p<.023$).

Hypothesis 5, Partially Supported: The path between IOS use for exploration and supply chain efficiency ($\beta_3=.283$, $p<.023$) is positive and significant. However, the path from IOS use for exploration to supply chain flexibility ($\beta_4=.130$, $p<.260$) is positive but not significant. So it's difficult to compare the association of IOS use for exploration with supply chain flexibility and the association of IOS use for exploitation with supply chain flexibility.

4. DISCUSSION AND CONCLUSIONS

4.1 Discussion

The study indicates that inter-organizational trust has significant positive influences on IOS usage, while power does not. Chinese culture is typically long-term oriented, supply chain collaboration is largely based on trust^[10]. When coercive power is applied to affect partners, they may take opportunistic actions to avoid punishment, which will reduce the effects of power^[23]. Besides that, conflicts will increase owing to the frequent use of power, which may impair the partners' willingness to cooperate^[12]. The explanation seems to be

supported by the research data. The study indicates that the minimum mean is 4.51 in the measure of trust, while the maximum mean of power's items is 3.89, which is less than 4. It declares that there is a weak feeling of power usage but a strong feeling of trust usage in supply chain collaboration. As a consequence, power may have no significant effect on IOS usage.

Besides, the study shows that the linkage between cooperative norms and IOS usage is non-significant. If organizations behave according to good cooperative norms, it may promote the level of IOS usage^[38]. Inter-organizational trust and cooperative norms could stimulate one another, but the base of supply chain collaboration is trust^[28]. So the influence of norms on IOS usage may be partially loaded by trust, which might lead to the non-significant results. The study found that the correlation coefficient between trust and norms is 0.390 ($p=.020$), which means a quite strong correlation between them. Therefore, cooperative norms have no significant influence on IOS usage in this study for the obvious correlation ($r=0.390$, $p=.020$).

The study indicates that IOS usage plays a positive role in promoting the level of supply chain performance and IOS use for exploration is better for the efficiency promotion. However, IOS use for exploration has no significant effect on supply chain flexibility. A major goal for most Chinese organizations is to reduce the risk, while exploration is associated with high risk^[13]^[36]. The study find that market turbulence has a significant influence on IOS use for exploration ($\lambda_8=0.526$, $p=0.002$), which might leads to a low level of exploration. And our results shows that maximum mean of exploration's items ($E1=4.52$) is much less than minimum mean in the measure of exploitation ($D4=5.11$), which indicates the level of IOS use for exploration is low. IOS couldn't be full use owing to the low level of IOS use for exploration^[39], so we guess that IOS use for exploration will have significant influence on supply chain flexibility once improved to a high level.

4.2 Conclusions and future research

This research presents the relationships between inter-organizational relationships, IOS usage and supply chain performance in Chinese Context. Through the empirical research, we draw the following conclusions: (a) Trust is positively related to both exploitative and exploratory use of IOS, however, (b) power and cooperatives norms have no significant influence on IOS usage. (c) The higher the level of IOS use for exploitation, the greater level of supply chain performance, and (d) the association of exploitation with supply chain efficiency is stronger than the association of exploration with efficiency. (e) The higher the level of IOS use for exploration, the greater the level of supply chain efficiency.

This study has three potential limitations. Firstly, the sample size is limited. The study get 151 valid samples through surveying, which ought to be added to 200 to ensure the stability of structural equation modeling^[37]. Secondly, some guesses need to be further studied. The study supposes that the influence of cooperative norms on IOS usage is loaded by trust, and the level of exploration might affect the influence of IOS use for exploration on supply chain flexibility. All guesses needed to be clarified in future study. Thirdly, the balance of IOS use for exploitation and exploration ought to be considered owing to their competitive relationship in the future.

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